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Vocational and technical education problem-based learning exercise: sample scenario

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Abstract

Survey was a qualitative study which was exposed to 30 students in the 1 st.semestre of 2008-2009 and completed in 2 weeks. Datas were gathered through student view forms, videos and problem evaluating forms. Content analysis, percentages and frequencies were calculated accordingly. In this study "factorial" was introduced to students in a scenario and this mathematical concept was expected to be understood by the students.

Key Words: Vocational and Technical Education; Mathematics; Problem-based learning; Factorial concept

1. Vocational and Technical Education

Vocational and technical education, is described as to educate people who can turn knowledge into production, make comments, solve problems, take responsibility and initiative in the production and development of materials and services (MEB, 1991). Industrial Vocational High Schools, being among the important schools in Vocational and Technical Education field, have 4 years of education after completing primary school education. These schools supply general culture and collective world view to students in high school levels. These schools are implementing programmes which supply traning education for various bussiness fields that the industry needs in order to prepare students for life, bussiness and higher education. Having a misson to educate the students for the need of bussiness life and in paralel to the student's interest and abilities, these schools fell behind in education. Studies have shown the success in vocational high schools in terms of social and numeric lessons were slower than the compared

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averages in other schools. Mathematics lesson, among the numerical lessons, has a very important place. Mathematics lesson is rather important since the analytical approach is the main issue in industrial education. But industrial vocational high schools students perceive mathematic as a hard lesson with too many equations and consider that they won't need in the future in their business lives. However, computer technology, electric, electronic, machine design, wood technology, automotive, metal and technical divisions, being the branches of industrial vocational high school, have mathematics in their basics. Students have these classes with hand-on methods. Therefore they are responsible from what they learn and gain problem solving experience. Survey aims at improving these technices mathematic education. Accordingly the new approach in mathematics learning interprets maths rather than just solve the problem (Olkun, 2002). In this period, it is important to make students discover the equations in order to progress their mathematical thinking abilitiy instead of memorizing nonsense equations that the students don't know where they were originated from (Olkun&Uçar, 2004). Therefore we need to have a new method in which we make math part of a real life and active methods which students will be held responsible from their learning. For this reason students were given to solve a real life problem by using problem-based learning method. This way, it is aimed to give meaningful and permanent learning.

2. Method

This study is a qualitative study which observes and comments the solving period. We prepared a scenario on "factorial" concept. Student's education level and real life situations are taken into consideration in preparation of the scenarios. Since the students who are having teacher based education, have no idea on PBL method, we introduce the method in 4 lessons each 40 min. for one week and another PBL scenario was introduced as a pilot study. In the second week, research method was carried in 4 lessons each 40 min. In these 4 lessons which are on the different days of the week we have the 1st lecture in the first 2 hour and the 2nd lecture in the rest. 30 students in the survey class form groups of 5 students and each group assigned a speaker. The scenario was introduced to every group. By means of sharing student's own experiences the scenario was internalized. Students who define the problem start to scope out the problem with the group. In this period, the teacher joined the group studies, and directed the students towards education by asking questions instead of just giving direct information. Students wrote their solutions and ideas on the scenario form. The students' studies were videotaped in this period. In the end of the lesson students' comments on the scenario were asked in the problem evaluation form. Datas gathered from this study are analyzed and are given below.

3. Findings

The PBL scenario which was introduced in this study is on "factorial" concept and is given in Table 1. With this scenario, it is aimed to teach students the definiton of factorial by multiplying number from 1… to n. Before this, we wanted students to realize how hard it is to multiply bigger numbers (1 to 20) where as multiplication of small numbers are obtainable (1 to 10).

Table 1: The scenario of my Father's Calculation

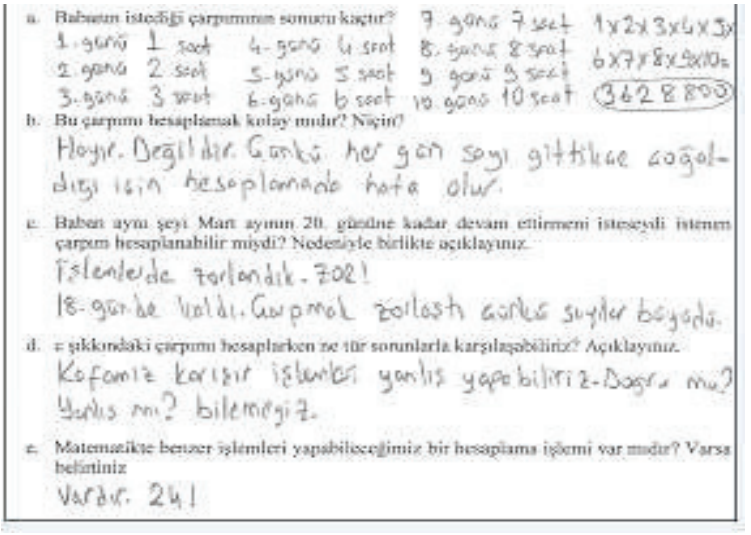
My Father's Calculation
There is a cellular phone with a built in camera which I have been dreaming of buying for a long time. I tried to buy it by saving my pocket money, but couldn't. Asked from mom, she replied "No". The idea of asking from my father is not a good idea because the phone is rather expensive. At last I found the courage to ask him. Surprisingly he said "Yes", but he had a condition; My father wants me to study one hour on the first day of March, two hours on the second day, three hours on the third day, four hours on the fourth day, five hours on the fifth day, six hours on the sixth day, seven hours on the seventh day, eight hours on the eighth day, nine hours on the ninth day and ten hours on the tenth day. Additionally, he wants you to multiply every studied hour with each other.

a. What is the result of the multiplication which your father asked?
b. Is it easy to multiply this? Why?
c. What if your father asked you to carry this till the 20 th of March, could it be multiplied? Why?
d. What kind of problems did you face when multiplying the numbers in c? Describe.
e. Are there any other solutions that can solve this in mathematics? If yes, describe.

Scenario written by Hatısaru (2007).

Students reached the result of the multiplication in section (a) of the scenario, but stated that it was hard to do it since the results were multiplied with the next and got harder as the figures grew bigger. But they couldn't reach the result of the multiplication to the question in section (c). Students reported that it was rather hard to reach the result as the figures were increasing exponentially as a result of the multiplication. Students who were working in a group thought that there must have been an easy method to solve the problem in section (e). Only group A discovered to use factorial in the 1st session. The answers of this group is given in Table 2. The other 4 group suggested "exponential numbers", "decimals", "multiplication, addition and subtraction" in the first session. Group B's anwers which was chosen among the other 4 group is given in Table 3. The rest of 3 groups have similar answers.

Table 2: The answers of Grup A


a. Babanın istediği çarpımının sonucu kaçtır? 1.gün 1 saat, 2.gün 2 saat, 3.gün 3 saat, 4.gün 4 saat, 5.gün 5 saat, 6.gün 6 saat, 7.gün 7 saat, 8.gün 8 saat, 9.gün 9 saat, 10.gün 10 saat. 1x2x3x4x5x6x7x8x9x10= 3628800
b. Bu çarpımı hesaplamak kolay mıdır? Niçin? Hayır. Değildir. Çünkü her gün sayı gittikçe çoğaldığı için hesaplamada hata olur.
c. Baban aynı şeyi Mart ayının 20. gününe kadar devam ettirmeni isteseydi istenen çarpım hesaplanabilir miydi? Nedeniyle birlikte açıklayınız. İşlemlerde zorlandık. ZOR! 18. günde hala çarpmak zorlaştı çünkü sayılar büyüdü.
d. c şıkkındaki çarpımı hesaplarken ne tür sorunlarla karşılaşabiliriz? Açıklayınız. Kafamız karışır işlemleri yanlış yapabiliriz. Doğru mu? Yanlış mı? bilemeyiz.
e. Matematikte benzer işlemleri yapabileceğimiz bir hesaplama işlemi var mıdır? Varsa belirtiniz Vardır. 24!

From the above Table 2, its seen that the students in Group A have answered the question (a) by writing the daily amount of working hours for each day and multiplying them with each other. Students answered the question "Is it easy to multiply this?" in (b) as "Not easy". They stated that since the figures grew bigger due to the multiplication the risk of mistakes increased. The students tried to reach the solution till the 20 th day insistantly given below in Table 3.

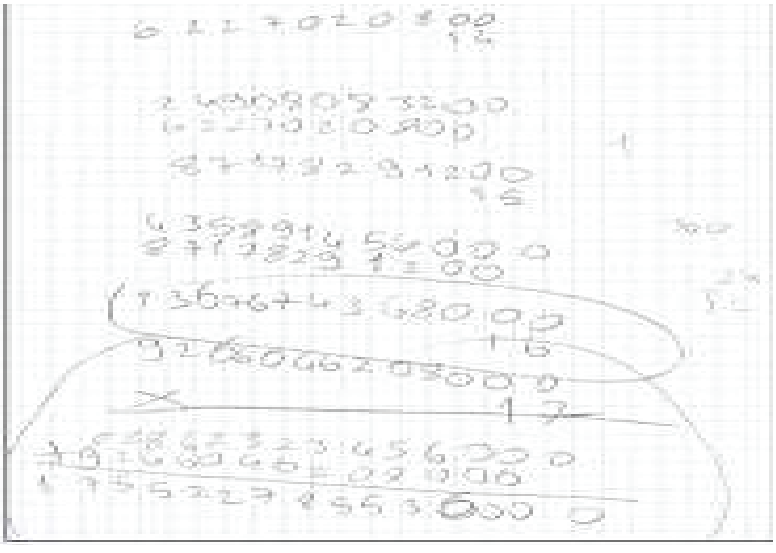
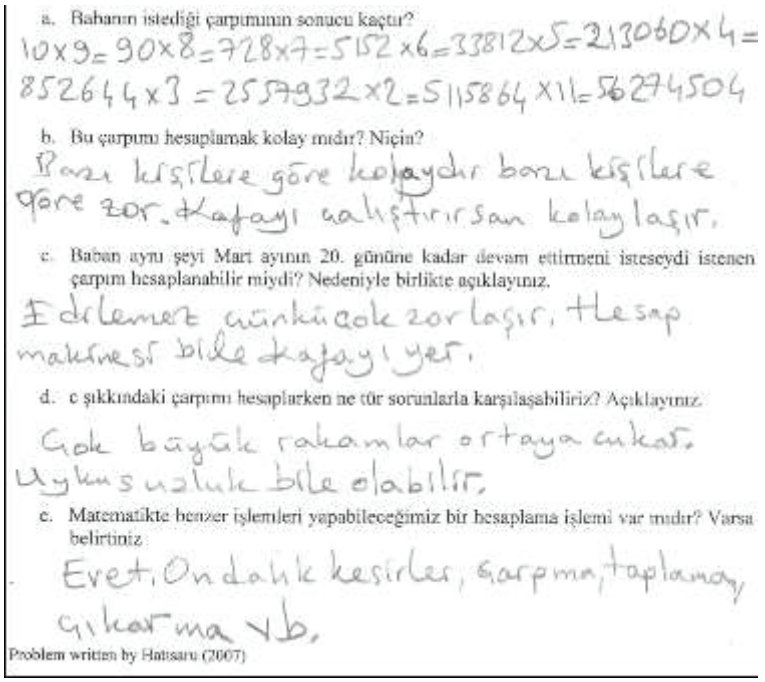


Table 3: Mutliplication of numbers from 1 to 20

Finally on the 18th day of multiplication they gave up multiplying. They answered the question in section (c) as "…as the numbers get bigger it becomes harder." The reason for this is our loosing control of calculation. In section (e) they discovered factorial in multiplying.

Table 4: The answers of Grup B


a. Babanın istediği çarpımının sonucu kaçtır?
10x9=90x8=728x7=5152x6=33812x5=213060x4=
852644x3=2557932x2=5115864x1=56274504

b. Bu çarpımı hesaplamak kolay mıdır? Niçin?
Bazı kişilere göre kolaydır bazı kişilere göre zor. Kafayı çalıştırırsan kolaylaşır.

c. Baban ayın şeyi Mart ayının 20. gününe kadar devam ettirmeni isteseydi istenen çarpım hesaplanabilir miydi? Nedeniyle birlikte açıklayınız.
Edilemez çünkü çok zorlaşır, hesap makinesi bile kafayı yer.

d. c şıkkındaki çarpımı hesaplarken ne tür sorunlarla karşılaşabiliriz? Açıklayınız.
Çok büyük rakamlar ortaya çıkar. Uykusuzluk bile olabilir.

e. Matematikte benzer işlemleri yapabileceğimiz bir hesaplama işlemi var mıdır? Varsa belirtiniz
Evet, Ondalık kesirler, çarpma, toplama, çıkarma vb.

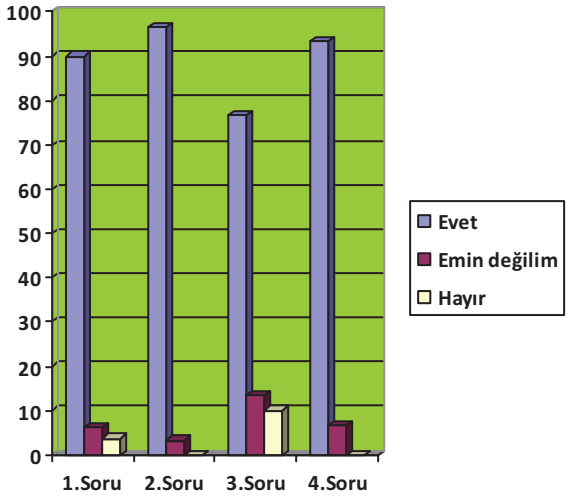
Problem written by Hatisaru (2007)

The analyse of Group B's anwers to the questions is given in Table 4. Students did mistakes in multiplying the numbers with each other starting from bacwards and in the calculations when answering to question in section (a). Students thought that multiplying numbers from 1 to 10 was easy for some, hard for the others in question (b). From the sentence "If you think and work hard it will get easier" students point out that the solution could be reached by working hard. Students answered the question in section (c) as "… the multiplying of numbers from 1 to 20 could not be reached ." The students kept on trying to make the multiplication by using a calculator. Since the calculator digit capacity is limited by 10 digit numbers, they ended up by saying that even the calculator went crazy. Students spent long time periods on multiplying the numbers and had a hard time since the numbers grew bigger. They discovered that solving the problem in this method would have difficulties concerning the time sued, by answering the question in section (d) as "sleeplessness could occur". The teacher realized that they couldn't reach the "factorial" definition as a result of internalizing the problem and spending a lot of time. In the end of the first session the teacher asked students to define the problem and to realize what they are trying to learn/ research before replying to the question as "Yes" or "No". In the end of the 2nd session which was held next day, the students discovered the factorial definition after they made some research. When asked about their research sources, students replied that they got professional help. Here we see that they reached the solution by the help of a professional instead of their own research. Students were expected to find various sources and to make their own research in reaching the solution. For this reason, schools must have necessary basic facilities .In the end of the research "Problem evaluation form (Table 5)" was distributed to the group.

Table 5: Problem evaluation form

	Yes	Not sure	No
The problem included the subjects that we have to learn			
Our work and research ability increased with the group			
Association of Mathematic with real life			
Suitable for our class grade			
Comments:			

Adapted from Delisle (1997).



Students had answered the questions "My Father's Calculation" scenario in the "Problem evalution form" as "Yes", "Not Sure", "No" grading from 1 to 3 respectively. The percentages of the grades obtained from the evaluation form were taken and a chart was prepared. We can see that 90% of the students think that the problem has an educational issue. 90% think working with group increases their work and research abilities, almost 80% associate maths with real life and more than 90% believe that it is suitable for their grade which can be seen from the below chart.

4. Conclusion

As a result, students worked solving the problem in the scenario and discovered the difficulties of multiplication. And they also found out that real life problems could not be solved without the help of mathematical concepts. Only one group out of 5 who took the survey discovered the factorial concept. We think this is the result of a lack of research in vocational high schools. Having reached the factorial concept by the help of a professional showed that students were still under the influence of teacher based education. In time, students' interactive studies and research efforts even if it was not satisfactory, increased their interest in maths lesson and progress positive approaches. In professional education, in order to use PBL method efficiently, students should be informed about making research and reaching various research sources.

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